Six Key Steps for Developing and Using Predictive Tools at Your Beach

Presented by

Samantha Fontenelle, USEPA

Joanna Mott, James Madison University

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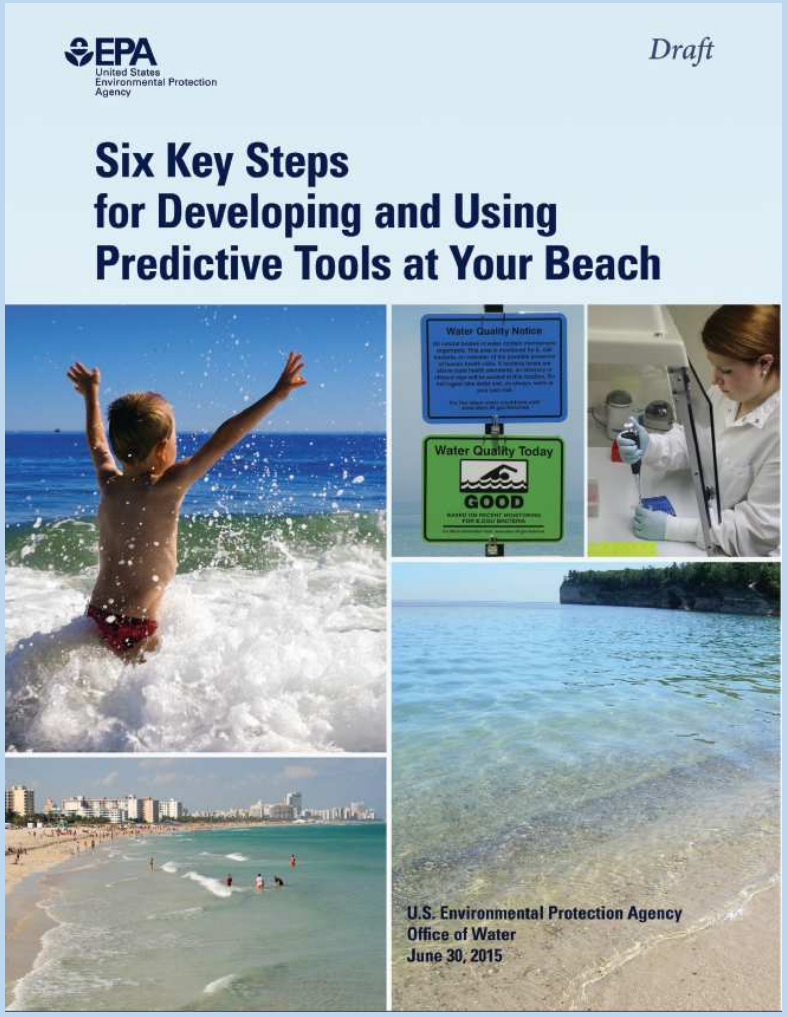

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1. Purpose of this Predictive Modeling Guide
   - This modeling guidance was written to provide non-technical information on developing a predictive tool for a beach.
   - It is meant to encourage beach managers to investigate whether a predictive tool would be an appropriate and cost-effective addition to their beach monitoring and notification programs.
   - It focuses on using Virtual Beach, but applies to other types of predictive tools as well.

2. Intended Audience
   - The guide was written for beach managers, local government officials, health department personnel, and other stakeholders.

Approach to Developing the Guide

- Interview beach managers who have developed a predictive tool.
- Use the information from interviews, along with other key sources on predictive tools, to develop an easy to follow guide on the key steps for developing and using a predictive tool at a beach.
- Pilot test the guidance by recruiting a beach program to develop a predictive model for one or more beaches using our draft document to guide the process.
- Revise the guide based on their feedback.

How we recruited volunteers for the interviews

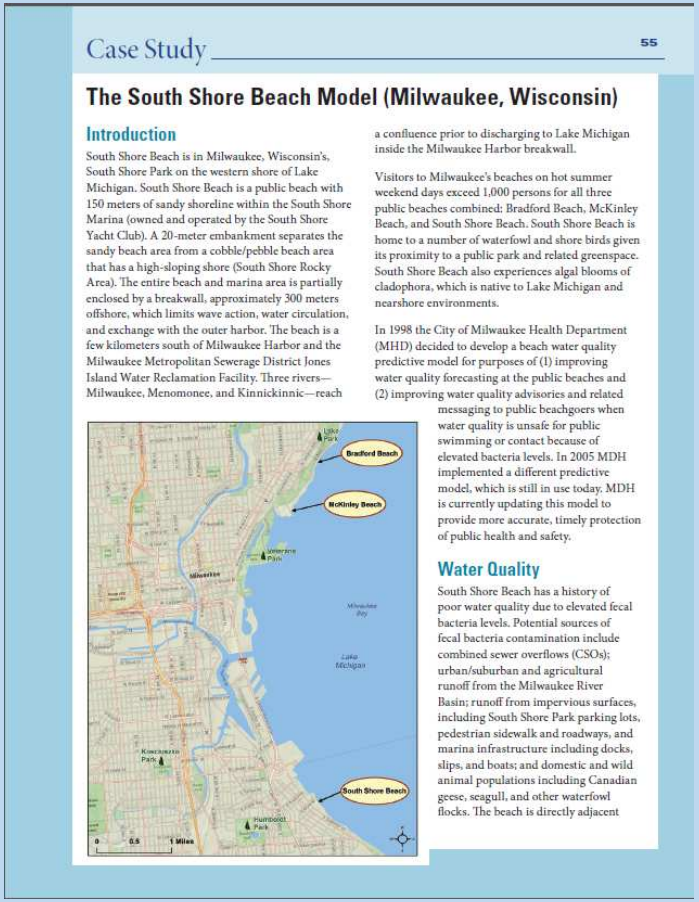
- Began with list of developed models from EPA's 2010 *Predictive Tools for Beach Notification Volume I*.
- Tried to select models from geographically diverse areas as well as different types of models.
- Contacted state and local Beach Program Managers currently using models to see who would be interested in helping EPA by being "interviewed."
- Sent them a detailed list of questions on their experience with developing a predictive model and followed up with a phone interview.

Questions for Interviewees

- Developed a questionnaire, with such questions as:
  - Why did you develop a model?
  - What variables did you use and how did you choose them?
  - Where did you go for guidance?
  - What problems did you encounter?
  - What was the cost?
  - How is the model being used and what are your future plans?
  - What are some key lessons learned?
- Prepared five case studies based on responses, which are included at the end of the guide.
- Incorporated information from the interviews into various sections of the guide.

Case Studies

- The South Shore Beach Model (Milwaukee, WI)
  - Paul Biedrzycki
- Charles River Watershed Association Flag Program (Boston, MA)
  - Julie Wood (Charles River Watershed Association)
- Chicago Park District Beach Modeling (Chicago, IL)
  - Cathy Breitenbach (Chicago Parks District)
- City of Racine Nowcast Model (Racine, WI)
  - Julie Kinzelman (City of Racine) and Stephan Kurdas (City of Racine)
- Stormwater Model (Horry County, SC)
  - Sean Torrens (SCDHEC) and Dwayne Porter (USC)



Case Study 55

The South Shore Beach Model (Milwaukee, Wisconsin)

Introduction

South Shore Beach is in Milwaukee, Wisconsin's, South Shore Park on the western shore of Lake Michigan. South Shore Beach is a public beach with 150 meters of sandy shoreline within the South Shore Marina (owned and operated by the South Shore Yacht Club). A 20-meter embankment separates the sandy beach area from a cobble/pebble beach area that has a high-sloping shore (South Shore Rocky Area). The entire beach and marina area is partially enclosed by a breakwall, approximately 300 meters offshore, which limits wave action, water circulation, and exchange with the outer harbor. The beach is a few kilometers south of Milwaukee Harbor and the Milwaukee Metropolitan Sewerage District Jones Island Water Reclamation Facility. Three rivers—Milwaukee, Menomonee, and Kinnickinnic—reach a confluence prior to discharging to Lake Michigan inside the Milwaukee Harbor breakwall.

Visitors to Milwaukee's beaches on hot summer weekend days exceed 1,000 persons for all three public beaches combined: Bradford Beach, McKinley Beach, and South Shore Beach. South Shore Beach is home to a number of waterfowl and shore birds given its proximity to a public park and related greenspace. South Shore Beach also experiences algal blooms of cladophora, which is native to Lake Michigan and nearshore environments.

In 1998 the City of Milwaukee Health Department (MHD) decided to develop a beach water quality predictive model for purposes of (1) improving water quality forecasting at the public beaches and (2) improving water quality advisories and related messaging to public beachgoers when water quality is unsafe for public swimming or contact because of elevated bacteria levels. In 2005 MDH implemented a different predictive model, which is still in use today. MDH is currently updating this model to provide more accurate, timely protection of public health and safety.

Water Quality

South Shore Beach has a history of poor water quality due to elevated fecal bacteria levels. Potential sources of fecal bacteria contamination include combined sewer overflows (CSOs); urban/suburban and agricultural runoff from the Milwaukee River Basin; runoff from impervious surfaces, including South Shore Park parking lots, pedestrian sidewalk and roadways, and marina infrastructure including docks, slips, and boats; and domestic and wild animal populations including Canadian geese, seagull, and other waterfowl flocks. The beach is directly adjacent

Additional Interviewees

- Shannon Briggs (Michigan Department of Environmental Quality)
- Adam Mednick (Wisconsin Department of Natural Resources)
- David Rockwell (University of Michigan)
- Dan Ziegler (Ozaukee County Public Health Department)

What We Learned

- Some beaches are not good candidates for predictive modeling.
  - Beaches that operate under a wide and unpredictable set of conditions.
  - FIB densities rarely exceed the beach notification threshold value.
- Data are the lifeblood of predictive tools.
  - High-quality historical data are needed to construct and validate the tool.
  - High-quality real-time data are needed to run the model and make same-day predictions.
- Predictive tool must be fully integrated into the overall beach monitoring and notification program.
  - In many programs, model results are part a multiple lines of evidence in the decision-making process.
- Beach managers must evaluate model accuracy on a regular basis and be ready to recalibrate in response to changing conditions.

The Six Key Steps

- Step 1—Evaluate the appropriateness of a FIB predictive tool
- Step 2—Identify variables and collect data
- Step 3—Perform exploratory data analysis
- Step 4—Develop and test a predictive model
- Step 5—Integrate the predictive tool into a beach monitoring and notification program
- Step 6—Evaluate the predictive tool over time

Key Comments from Pilot Demonstration Project

- You need staff with experience in data management.
- Provide clear guidance on the amount of data needed, how to handle changes like sample frequency, sampling time, analytical methods.
- Need more guidance on data management, such as:
  - How to handle missing data (i.e., what method to use to fill in gaps)
  - How to handle beaches with more than one monitoring station or multiple samples
  - Which rainfall parameter is best to use
  - Would like a pro/con list for VB as well as other types of models.

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Questions